PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Damping Device for Tools or their Holders or for Workpieces or their Holders

We, KARL HULLER, G.m.b.H., a German Company, of Grönerstrasse 7, Ludwigsburg, Germany, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to damping means for tools or their holders or for workpieces or their holders, such as are securely and detachably affixable by clamping means to a member of a machine tool for receiving the same.

The working range of tools, toolholders, workpieces and workholders that are subjected to the machining thrust depends upon their rigidity to prevent chatter. In order to ensure satisfactory operation of say boring tools, the diameters of their shanks are usually designed to be a quarter of their length. Proposals have already been made to improve the static and dynamic rigidity of boring tools to permit the ratio of length to diameter of the shanks to be substantially modified for the purpose of widening their working range. However, these proposals have now so far not adduced satisfactory results.

For instance, such tools have already been made of high grade materials possessing high moduli of extension and elasticity, such as tungsten carbide, and attempts have also been made to achieve the same result by incorporating a free unsupported flywheel mass (energy absorber) in the shank. However, the improvements in working range thus obtained never exceeded 50%.

It has now been found that the build-up of self-excited oscillations in tools, toolholders, workpieces and workholders can often be eliminated and their dynamic rigidity substantially improved by the combination, according to the present invention, of a holder for a tool or workpiece, and pads of vibration damping material, the holder comprising a base, a clamping element and means for drawing the element towards the base and thereby causing clamping pressure to be applied to a tool or workpiece when arranged between the said base and element, the said pressure being applied to the tool or workpiece solely by the said pads, the said base and element having faces formed for locating the pads thereon. Such damping pads prevent the establishment of a vibration-transmitting connection between the vibratory system, such as a boring tool or an unsupported arbor and its collet or socket. Although this arrangement reduces the static rigidity (spring rate) of the system it substantially improves its dynamic rigidity. The stability limit is thus shifted in a direction that substantially widens the working range within which no self-excited vibrations will occur.

Conveniently the material to be used for the damping pads is one which will provide an improvement in dynamic rigidity corresponding to a ratio of the dynamic rigidity of the tool or its holder or of the work or its holder in conjunction with the damping pads to that without the damping pads of between 1 and 50, and at least between 1 and 30 and preferably between 10 and 30.

Such a material is available in the form of a plastics material with a dispersion range preferably in the region of the usual temperature of tools or work during machining operations, a suitable plastics material being for instance polyvinyl chloride, preferably a plasticised polyvinyl chloride. This material ensures that the ratio of the mechanical loss factor (damping factor of the material) of the vibrator system to that of the damping pads is in the range between 1:5 and 1:200, preferably above 1:10.

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Whereas the damping effect of steel or cast iron is extremely low and parts made of such materials, such as tools or their holders or work or its holder, can build up vibrations due to resonance by a factor of between 50 and 1000, the use and interposition according to the invention of pads preferably of plasticised polyvinyl chloride improve the dynamic rigidity by a factor of 10 or more. Such an improvement in dynamic stability which therefore depends upon the ratio of the damping effect of the plastics material used to that of the vibratory system of steel, cast iron or the like permits, for instance in the case of a boring tool, the ratio of length to diameter to be sufficiently modified for the length of the shank of the boring tool to be eight to ten times its diameter.

It must be borne in mind that the plastics material selected for the damping pads must not have a damping effect which, particularly in the case of a plasticised plastics material and preferably plasticised polyvinyl chloride, is so high that when tightly compressed the material will start to flow, because this would necessarily allow the tool or its holder to deviate beyond the allowable limits of its adjusted working position and thus cause impermissible deviations from the required dimensions of the machine surface.

After the selection of a suitable plastics material, such as a polyvinyl chloride that has been appropriately plasticised, the required static rigidity of the damping member for an optimum adjustment of dynamic rigidity at a given damping ratio can be achieved by variation of the clamping pressure. This will change the geometric shape of the damping pads within its elastic region.

In a preferred construction, the base and element are adapted to clamp a plate-like foot formed on the tool or workpiece, in which case the foot may be circular and the base and element are adapted to clamp the circular foot by the provision of screw-threaded holes distributed circularly on the operative face of the base and correspondingly distributed holes through the element, and headed bolts the shanks of which extend through the holes through the element and make screw-thread engagement with the holes in the base. Moreover, the element may be adjustably tiltable with respect to the said base by rotating one of the bolts, an index and reference scale for indicating the angular position of the bolt being associated with the bolt and the element.

So that the invention may be more readily understood, reference will now be made to the accompanying drawings which show a boring tool and blade adapted in the manner proposed by the present invention. In the drawings:—

Fig. 1 is a plan view of a boring tool held in the chucking means of a machine tool,

Fig. 2 is a section taken on the line 2—2 in Fig. 1, and

Fig. 3 is a fragmentary section taken in the line 3—3 in Fig. 1 and drawn on a larger scale.

The shank of a boring tool generally indicated by reference number 10 is formed with a fixing flange 12 adapted to be received into a chocking means generally indicated by 14. The latter comprises a tool carrier base or plate 18 detachably fitted to a machine spindle 16 indicated in dot-dash outline. The face of the plate is formed with a flat circular central projection 20.

The flange 12 on the shank of the boring tool faces this flat projection with the interposition of a plurality of damping pads or members 22 according to the invention made of plastics. The boring tool is affixed to the tool carrier plate 18 by means of a clamping element in the form of an annular member 24 which presses against the underside of the flange 12, viewed from the working end of the tool. A plurality of damping members 26 is likewise provided between this annular member and the underface of the flange.

For the retention of the annular member 24 tightening elements generally indicated by reference number 28 are provided, comprising for instance four tightening elements or bolts located in relative quadrature.

In the illustrated embodiment the several damping members are of flat circular cylindrical plate shape, disposed at equiangular intervals at angles of 45° to the bolts 28. For the reception of the damping members suitable shallow cylindrical sockets are formed on both faces of the fixing flange 12 of the boring tool as well as in the co-operating projecting face 20 and in the face of the annular member 24. This arrangement simultaneously ensures that the boring tool is correctly centred in relation to the tool carrier plate.

The bolts 28 in Fig. 3 are formed with heads 30 which are countersunk in the undersurface 32 of the annular member 24. The shanks 34 of the bolts pass through annular member 24, preferably with some clearance, as well as through a hole 36 in the fixing flange without touching the walls of the hole. The threads of the bolts engaged tapped holes 38 in the tool carrier plate. One of these bolts, preferably that on the side where the shank of the boring tool carries the blade 41, shown in discontinuous lines in the drawing, has a head 30 formed with an additional flange 42 provided on its outside face with a scale 44 for co-operation with an index mark 48 on a cap-shaped member 46.

Because the bolts 28 make no contact with the fixing flange of the boring tool, and by virtue of the provision of a plurality of damping members between the fixing flange and the parts facing the same on either side, the

static rigidity of the damping members can be varied by appropriately adjusting the bolts to provide the required dynamic rigidity of the boring tool.

In order to permit the arrangement to be used for the fine adjustment of the shank and its blade, only the bolt provided with the scale marked 44 need be turned for applying a desired amount of extra or less compression to the damping members on one side and thereby slightly tilting the tool.

The degree of tilt of the tool can be checked against the reading of the reference scale 44.

The purpose of member 46 is to protect the above-described clamping, damping and fine adjustment means against contamination by dirt and from damage. This member 46 is a cap-shaped cover which is bolted to the tool carrier plate and through which the shank of the boring tool passes in an annular seal 50.

WHAT WE CLAIM IS:—

1. The combustion of a holder for a tool or work-piece, and pads of vibration damping material, the holder comprising a base, a clamping element and means for drawing the element towards the base and thereby causing clamping pressure to be applied to a tool or work-piece when arranged between the said base and element, the said pressure being applied to the tool or workpiece solely by the said pads, the said base and element having faces formed for locating the pads thereon.

2. The combination according to Claim 1, wherein the said faces are formed with depressions for locating the pads.

3. The combination according to Claim 1 or Claim 2, wherein the pads consist of a synthetic plastics material.

4. The combination according to any one of Claims 1 to 3, wherein the pads consist of polyvinyl chloride.

5. The combination according to any one of claims 1 to 4, wherein the pads consist of plasticised polyvinyl chloride.

6. The combination according to any one of the preceding claims, wherein the base and element are adapted to clamp a plate-like foot formed on the tool or work-piece.

7. The combination according to Claim 6, wherein the base and element are adapted to clamp a circular plate-like foot on the tool or work-piece by the provision of screw-threaded holes distributed circularly on the operative face of the base and correspondingly distributed holes through the element, and headed bolts the shanks of which extend through the holes through the element and make screw-thread engagement with the holes in the base.

8. The combination according to Claim 7, wherein the element is adjustably tiltable with respect to the said base by rotating one of the bolts, an index and reference scale for indicating the angular position of the bolt being associated with the bolt and the element.

9. The combination of a holder for a tool or work piece, and pads of vibration damping material, constructed and arranged substantiaally as herein described, with reference to and as illustrated in the accompanying drawing.

10. The combination according to any one of the preceding Claims, which further includes a tool or work-piece clamped in the holder, wherein the increase in dynamic rigidity determined by the ratio of the dynamic rigidity of the tool or work-piece together with the said pads, to the dynamic rigidity of the tool or work-piece without the said pads, is in the range 1 to 50.

11. The combination according to Claim 10, wherein the said increase in dynamic rigidity is in the range 10 to 30.

12. The combination according to Claim 10 or Claim 11, wherein the ratio of mechanical loss factors in the tool or work-piece to such factors in the said pads is in the range 1:5 to 1:200.

13. The combination according to Claim 12, wherein the said ratio of mechanical loss factors is above 1:10.

14. The combination of holder, tool and pads of vibration damping material, constructed and arranged substantially as hereinbefore described, with reference to the accompanying drawing.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

Fig. 1

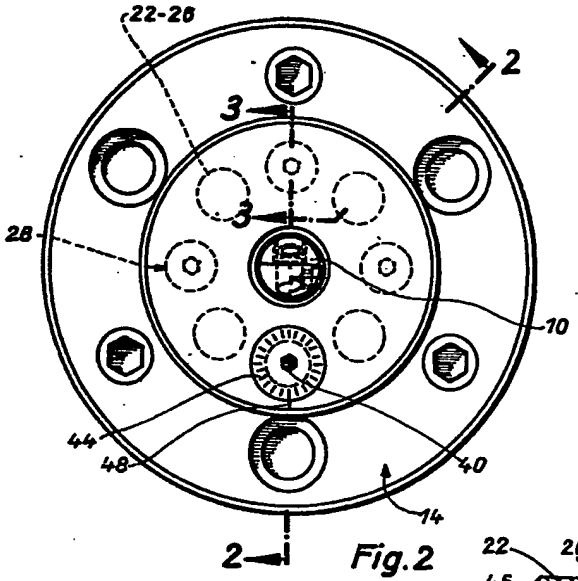

Fig. 2

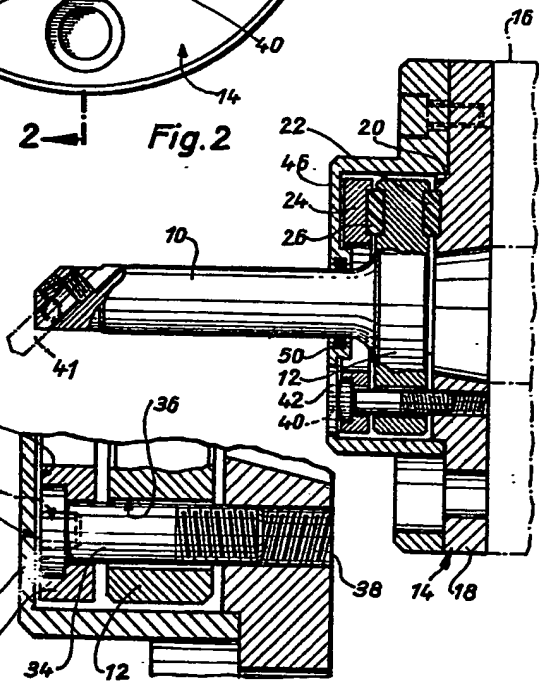

Fig. 3